On the Relative Motion of the Components of 6 p Eridani.
By A. M. W. Downing, M.A.

In his recently-published *Double-Star Results*, 1871–1881—a valuable contribution to our knowledge of a hitherto too much neglected department of southern astronomy—Mr. Russell has inserted a note on the southern double star 6 or *p Eridani*, to the effect that the hypothesis that the relative motion of the components is rectilinear and not orbital accords better with all the observations made since Herschel's time, and that therefore, if subsequent observations confirm this result, we must conclude that this star is no longer to be reckoned amongst the known binary systems.

As the point thus raised by Mr. Russell is one of considerable interest, I have thought that it would be worth while to discuss analytically all the available observations (including those made at Sydney) of this star, in order to see if it would be possible to decide between the rival hypotheses. And, as Dr. Doberck has published elements of the star in which the Sydney observations have not been included, it will be possible to see what is the effect of the later observations in modifying these elements.

Dr. Doberck's elements are (*Ast. Nach.* No. 2148)—

$$
\begin{aligned}
P &= 117{\cdot}51 \text{ years} \\
T &= 1817{\cdot}51 \\
e &= 0{\cdot}378 \\
\Omega &= 81^\circ\ 42' \\
\lambda &= 327\ \ 15 \\
\gamma &= 44\ \ 40 \\
a &= 3''{\cdot}82
\end{aligned}
$$

This double star was first measured by Dunlop in 1825, secondly by Herschel in 1835. Mr. Russell states that neither of these observations accord with the hypothesis that the motion is in a straight line, but that Herschel's *angle* is nearly correct, his distance being a little too small. Dunlop's observation does not agree with the place computed from Dr. Doberck's elements for that epoch, and is probably quite inaccurate, I have therefore made no use of it in deducing new elements, but I have not felt at liberty to reject Herschel's observation, especially as the angle only is used in determining all the elements with the exception of the semi-axis major. (It will be seen that Herschel's observed distance has not been used in determining this latter element.) I have accordingly formed the following six normal angles from the observations by combining them in convenient groups (the angles being reckoned from the circle of declination passing through the principal star at the epoch 1870·0).

	Epoch.	Position-Angle.
I.	1835·03	302°·44
II.	1846·12	276·35
III.	1851·83	266·69
IV.	1858·36	257·58
V.	1870·92	242·08
VI.	1878·68	236·38.

It was evident that Dr. Doberck's period would have to be considerably increased to represent these normal places, and it was found by trial that the following values would nearly represent the observed angles—viz. P=235·02 years, T=1810·98, and e=0·4. From these were computed true anomalies corresponding to each epoch, and hence (using Dr. Doberck's values of ☊, λ and γ) the corresponding position-angles were found. Then by varying successively λ and γ each 1° the differential coefficients of θ (position-angle) with respect to each of these elements were determined, $\frac{d\theta}{d☊}$ being of course unity; and by comparing the computed and normal position-angles six equations of condition were formed to determine the corrections to ☊, λ and γ. These being solved by the method of least squares, the new values were ☊=47° 22′, λ=330° 22′, and γ=25° 56′. From these new values were then found true anomalies corresponding to each normal epoch; and from these, with values of the eccentricity e=0·4 and e=0·5, two sets of mean anomalies were computed; and from the errors of these a corrected value of e was found by interpolation, and hence corrected values of P and T were deduced. The values of ☊, λ and γ were again corrected in the manner described above; and finally a was found from all the measures of distance (excluding Dunlop's and Herschel's) in combination with the new values of the other elements.

The elements are then as follows—

P = 224·57 years
T = 1814·43
e = 0·4127
☊ = 48° 0′ (1870·0)
λ = 329 52
γ = 26 5
a = 4″·75

As these elements very fairly represent all the measures except Dunlop's angle (as will be seen from the detailed comparison with observation, given below), they were adopted, as being sufficiently accurate for the present purpose.

We have now to proceed on the assumption that the motion

of the *comes* is uniformly in a straight line—of course excluding Dunlop's and Herschel's measures, as they are manifestly inconsistent with this hypothesis.

Using, then, the last five of the normal position-angles given above, with corresponding values of the observed distances, the equation to the "most probable" right line passing through these five points is—

$$4{\cdot}163 = \rho \cos (\theta - 282^\circ\ 1');$$

and the epoch of nearest approach of the components on the assumption of rectilinear motion being 1842·62, the distance (ρ) and position-angle (θ) at any time t are found from this equation in combination with—

$$0{\cdot}1205\ (1842{\cdot}62 - t) = 4{\cdot}163 \tan (\theta - 282^\circ\ 1').$$

The following table contains the comparison with the individual annual results, the discordances under (I.) being those resulting from the assumption of elliptic motion, and those under (II.) from the assumption of rectilinear motion :—

Epoch.	Observer.	θ_o	$\theta_o - \theta_c$ (I.)	$\theta_o - \theta_c$ (II.)	ρ_o	$\rho_o - \rho_c$ (I.)	$\rho_o - \rho_c$ (II.)
1825·96	Dunlop	343°·1	+9°·8	+35°·5	2″·5	−0″·27	−2″·12
35·03	Herschel	302·3	−0·3	+8·0	3·65	+0·46	−0·61
45·88	Jacob	276·0	−0·8	−0·5	4·16	+0·24	−0·02
46·35	,,	276·5	+0·5	+0·5	4·32	+0·36	+0·13
49·82	,,	270·0	+0·2	−0·2		—	
50·80	,,	268·7	+0·5	+0·1		—	
51·79	,,	266·4	−0·1	+0·3	4·30	−0·03	−0·01
52·76	,,	264·8	−0·2	−0·8	4·14	−0·25	−0·20
53·96	Powell	263·2	0·0	−0·6		—	
56·09	Jacob	261·1	+0·5	+0·4	4·70	+0·07	+0·23
57·96	,,	258·1	+0·3	0·0	4·49	−0·24	−0·07
61·03	Powell	253·4	−0·3	−0·6	4·86	−0·03	+0·14
70·92	Russell	242·1	−1·0	−0·6	5·46	+0·02	+0·08
77·03	Ellery	237·3	0·0	+0·1	5·0	−0·73	−0·88
78·34	Russell	236·7	+0·6	+0·5	6·09	+0·30	+0·10
79·93	Hargrave	237·3	+2·6	+2·4	5·44	−0·40	−0·69
1880·44	Russell	234·7	+0·4	+0·2	6·30	+0·43	+0·13

In this table θ_o and ρ_o are the observed, θ_c and ρ_c the computed, position-angles and distances respectively; the computed position-angles being corrected for the effect of precession. It appears from this comparison that the hypothesis of orbital motion represents the whole series of observations fairly well, whilst that of relative rectilinear motion does not; and that

even confining ourselves to measures made subsequent to Herschel's observation, the discordances from the first assumption are on the whole no larger than those from the second. It would appear from this, therefore, that, as far as can be judged from the observations as yet published, there is not sufficient evidence to justify us in asserting that *p Eridani* is other than a binary star. It is to be hoped that observers in the southern hemisphere will not lose sight of this interesting double star, but will continue to measure it from time to time.

With regard to the proper motions of the components, it appears from a comparison of their places in the Cape Catalogue for 1840 with those in the Cape Catalogue for 1880 that they have a common proper motion of $+0^{s}\cdot03$ in Right Ascension; whilst in North Polar Distance that of the preceding star (the *comes*) is $+0''\cdot07$, and that of the principal star $-0''\cdot08$. These latter values would support the hypothesis of the *comes* moving relatively in a straight line towards the south, but unfortunately the N.P.D. of the following star in the Cape Catalogue for 1840 depends on a single observation, and therefore no reliance can be placed on the proper motion deduced from it.

Blackheath:
1883, *March* 8.

Notes on some of Schjellerup's Identifications of Al-Sufi's Stars. By J. E. Gore, M.R.I.A.

Some years since M. Schjellerup, the well-known astronomer, published a French translation of two Arabic manuscripts containing a description of the heavens written in the tenth century by the Persian astronomer Al-Sufi. Schjellerup's translation is entitled *Description des Etoiles Fixes, composée au milieu du dixième siècle de notre ère par l'astronome Persan, Abd-al-Rahman Al-Sufi* (St. Pétersbourg, 1874). Schjellerup gives a synopsis of the stars observed by Al-Sufi, identifying Al-Sufi's stars with those at present recognised by Greek and Roman letters, and also giving the magnitude of each star as estimated by Ptolemy, Al-Sufi, and Argelander. I have carefully gone through all Al-Sufi's descriptions of each constellation, comparing his account of the position of each star with the stars as shown in the atlases of Behrmann, Heis and Proctor, and find that in the great majority of cases Schjellerup's identifications are very correct. There are, however, a good many cases in which I cannot agree with Schjellerup with reference to the star described by Al-Sufi. In the Harvard College *Annals*, vol. ix. p. 48, Peirce gives several cases in which he disagrees with Schjellerup, and to these I have added several others. The following are all the cases in which I differ with Schjellerup:—

Hercules.—Two stars mentioned by Al-Sufi amongst the "externes" of this constellation (page 73) as following